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Ministry of Policy and Program
Housing Development Secretariat




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HOUSING DEMAND BY TENURE IN ONTARIO

FOR THE PERIOD 1976 TO 1981

— A NEW APPROACH



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Ontario

Ministry of Policy and Program
Housing Development Secretariat

Hon. Claude F. Bennett, Minister

Donald A. Crosbie, Deputy Minister

HOUSING DEMAND BY TENURE IN ONTARIO

FOR THE PERIOD 1976 TO 1981

— A NEW APPROACH

Prepared by

Policy and Program Development
Secretariat

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TABLE OF CONTENTS

	<u>PAGE</u>
I. INTRODUCTION AND SUMMARY OF RESULTS	1
II. METHODOLOGY	7
III. TESTING THE PREDICTIVE ABILITY OF THE REGRESSION ANALYSIS	16
IV. FORECAST OF HOUSING DEMAND BY TENURE	18
V. COMPARISON OF THE REGRESSION ANALYSIS WITH THE HEADSHIP RATE METHOD	27
VI. CONCLUSIONS	31

APPENDICES

A. Definitions and Assumptions	A-1
B. Technical Explanation of the Regression Method	B-1
C. Headship Rate Methodology	C-1

All statistical programs utilized in this study were developed by T. Garrison. The report was written by R. Stocking.

I. INTRODUCTION AND SUMMARY OF RESULTS

Introduction

The purpose of this study was to develop and evaluate a method of forecasting housing demand in the medium-term period (five years). The technique used a unique application of regression analysis that has not been employed before in forecasting housing demand.

An important aspect of the analysis was that it provided an estimation of the quantitative impact of specific economic and social factors on housing demand. Thus, it allowed for assessing the impact of different socio-economic scenarios on Ontario's housing market.

A long-term housing requirements study was prepared for the Ministry of Housing by Peter Barnard Associates Ltd. in February 1977. This study utilized the headship rate method, which has been the commonly used method of forecasting housing requirements. (An explanation of the headship rate methodology is given in Appendix C). A comparison of the results obtained from the regression technique and the headship rate method is provided in Section V of the report.

To assist in the understanding of the analysis, some basic definitions covering terminology used are provided in Appendix A.

Methodology

The approach adopted was to use the regression technique to predict total housing demand and rental housing demand, leaving estimated ownership demand as the residual. This was because in comparison with the rates of change in all other variables tested for the period 1961-1976, ownership demand changed much faster between 1971-1975. Consequently, a mathematically stable equation for ownership could not be developed. However, a simple regression equation was developed using the 25-64 population age group as the sole independent variable to forecast ownership demand. This was used as a valuable checking point against the residual component.

The significance of a number of socio-economic factors was tested to determine how far they explained variation in the trend in housing demand. Results showed that in the case of total housing demand, two independent variables, namely the total population 15 years and over, and the average household size, were the most significant. Rental housing demand was heavily dependent on the trends in the combined 15-24 and over 64 age-group population. Other variables influencing rental housing demand that were used in the regression analysis were the unemployment rate, the number of divorces and the ratio of rent change to income change. (A detailed explanation of the methodology is provided in Section II).

It is important to note that not all the significant factors were used in the selected regression equations, due to the problem of double-counting in terms of effect on total housing demand. Hence, complete "specification" of the factors influencing housing demand was not attempted, but rather an optimal set of regression equations were developed in terms of stability and predictive reliability.

Summary

- The results of the regression analysis predicted an average annual increase of 71,500 in total households and 17,500 in rental households for Ontario in the period 1976 to 1981. This left the annual ownership household component as 54,000 in the same period.
- Adding 2,200 units for a 3.0% annual vacancy allowance factor and 4,000 units for annual net replacement demand, average annual housing requirements were projected at 77,700 units with the rental component being 20,000 units and ownership 57,700 units.

The forecasting method was tested by applying it to the period 1971-1976, for which actual figures are available. Table I.1 below compares these actual figures with those derived by the forecast method. From this table, it is apparent that the 'forecast' results were very close to actual figures, thus providing a good degree of confidence in the results for the period 1976-1981. (A detailed

explanation of how the forecasting method was tested is provided in Section III).

Table I.1

Regression Analysis Performance in Predicting
Housing Demand by Tenure in Ontario
1971 to 1976

Variable	Average Annual Increase in Housing Demand 1971 to 1976			
	Actual (Census)	Prediction	Difference	
	Units	Units	Units	%
Total Demand	81,826	85,500	3,674	4.5
Rental Demand	26,802	26,100	(702)	(2.6)
Ownership Demand	55,024	59,400	4,376	8.0

() denotes under-forecast.

Sources: Census data 1971 and 1976
P.P.D.S. Ministry of Housing.

The following Table I.2 compares actual average annual increases in housing stock for the period 1971-1976 with forecasted average annual requirements for 1976-1981, in total and by tenure, and shows the percentage changes between actual increases in the earlier period and expected requirements in the forecast period.

Table I.2

Average Annual Increase in Housing
Stock 1971-76 and Housing Requirements
1976-1981 by Tenure for Ontario

Variables	Average Ann. Increase in Housing Stock* 1971- 1976	Average Ann. Increase in Housing Requirements 1976-1981	Percentage diff. between the period 1976-81 and the earlier 5 Year period 1971-76
Total Units	91,269	77,700	(14.9)
- Rental Units	32,474	20,000	(38.4)
- Ownership Units	58,795	57,700	(1.9)

*Includes unoccupied housing stock
but excludes collective dwellings.

() Denotes a percentage decline.

Source: Housing Stock: Census data.
Housing Requirements: P.P.D.S.
Ministry of Housing.

- As can be seen from Table I.2, a sharp downturn is predicted in housing demand, particularly rental housing demand, for the period 1976 to 1981 in comparison to the earlier five year period 1971 to 1976.
- While the regression analysis provided annual estimates for the forecast period, the method was shown to be best suited for estimating total and average annual housing demand for the five year period 1976 to 1981.

- The nature of the regression method makes it useful as a medium-term (5 years) forecasting tool, since it is more difficult to predict changes in socio-economic variables over the long-term period.

II. METHODOLOGY

As explained in the Introduction (Section I), the overall approach undertaken was to forecast total housing demand and rental housing demand leaving ownership demand as the residual component.

Census data on households by type of tenure were used as a measurement of total housing demand and its rental and ownership components. The latest data used were from the 1976 Census. The various stages involved in the forecasting process are described below.

A. Total Housing Demand

An initial analysis was carried out using data for the following socio-economic variables (period 1961-1976).

- Over 15 aged population (Ontario)
- Shelter component of the Consumer Price Index (Toronto)*
- Average Resale Prices in Ontario
- Residential Construction Cost Index (Ontario)
- Unemployment Rate in Ontario
- Net Migration (Ontario)
- Total Mortgage Loans for New Residential Construction in Ontario
- Personal Income per Capita (Ontario)

*Data are not available for Ontario.

- Ratio of Shelter Costs/Personal Income per Capita (Ontario)
- Average Household Size in Ontario.

After some consideration of the results of testing these variables for their effect on total housing demand, it was decided to use a regression equation which only utilized two of these variables: namely, the over-15 aged population, and the average household size. The main reason for this decision was that it avoided the danger of double counting effects. Also, these two variables by their nature incorporate the essential trends in the other variables. Thus, the net migration factor has an effect on population growth, while the relative trends in cost and income factors influence average household size.

The projections of the over-15 aged population in Ontario from 1976 to 1981 were obtained from Central Statistical Services, Ministry of Treasury and Economics, and assumed a low fertility rate of 1.61% by 1986 and a net migration factor of 25,000 persons per annum.¹ The projected trend to 1981 in average household size was based on the long-term historical trend from 1961 to 1976. Thus, the indirect assumption is that the anticipated socio-economic

1

Ontario Short-Term Population Projections 1975-1986. The projected population trends to 1981 by age-group developed in this study were applied to the 1976 Census data base.

environment to 1981 will lead to a slowing in the rate of decrease in average household size compared with that which occurred in the period 1971 to 1976.

Table II.1 below shows the past and projected trends in the two selected independent variables.

Table II.1

Actual Data and Forecasts
of Selected Independent Variables
Ontario, 1961-1981

Years	Over 15-Aged Population		Average Household Size	
	Number of Persons	Average Annual Increase	Number of Persons	Average Annual Increase (Decrease)
1961	4,228,343	-	3.7	
1966	4,756,795	2.50	3.6	(0.54)
1971	5,494,605	3.10	3.4	(1.11)
1976	6,190,690	2.53	3.1	(1.76)
<u>Forecast</u>				
1981	6,774,462	1.89	2.9	(1.29)

Sources: Actuals: Census Data

Forecasts: Population: Central Statistical
Services, Ministry of
Treasury and Economics

Household Size: P.P.D.S. Ministry
of Housing.

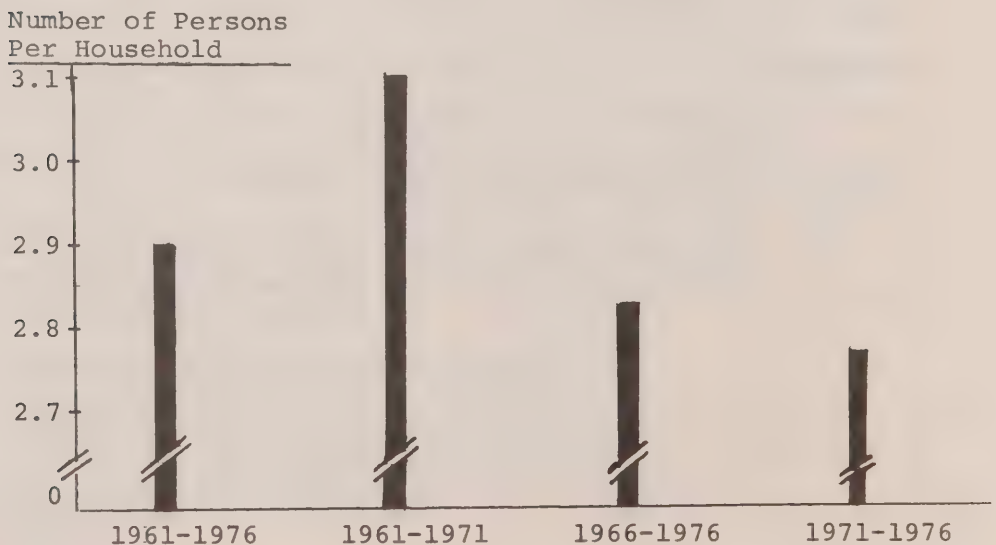
The selected regression equation's predictive ability was tested for the period 1971 to 1976 inclusive, using the data for the period 1961 to 1971. (Section III).

The regression equation was then used to forecast total housing demand in Ontario for the five-year period 1976 to 1981. (Section IV).

To develop a forecast range for total housing demand in Ontario for this period, variations in average household size were used with the population projections remaining unchanged. As a first approximation, average household size projections were made on the basis of different historical trends as shown in Chart II.1 below.

Chart II.1

Alternative Projections of Average Household Size for 1981 Based on Different Historical Trends



Source: P.P.D.S., Ministry of Housing.

The next step was to develop low and high assumptions for average household size, using the regression technique, based on actual low and high annual changes for five year periods since 1961.

The technical details and results of the regression equations used to forecast total housing demand are described in Appendix B.

B. Rental Housing Demand

The initial analysis involved testing the effect of the following socio-economic variables on rental housing demand.

- Combined 15-24 and over 64 aged population
- Average Weekly Wages and Salaries (Ontario)
- Rent Component of the Consumer Price Index* (Canda)
- Unemployment Rate (Ontario)
- Number of Divorces (Ontario)
- Vacancy Rate (Toronto CMA)*
- Rate of Urbanization (Ontario)
- Ratio of Rent to Income (Ontario)

The results indicated the existence of a 'dominant' variable, notably the combined 15-24 and >64 aged population whose trend showed a very high correlation

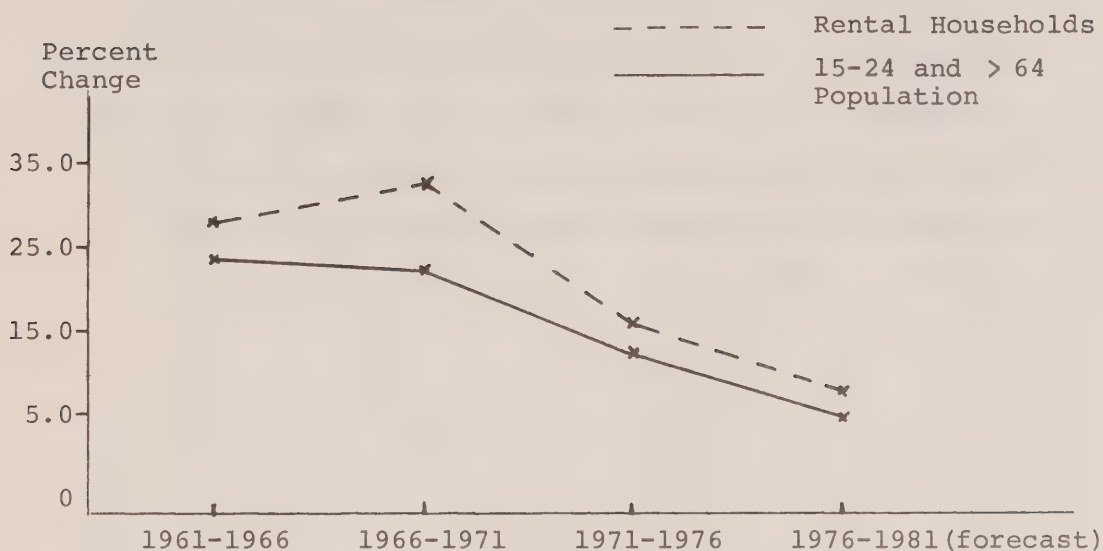
*Data are not available for Ontario.

with the trend in rental households. This population variable was dominant in terms of explaining most of the variation in the dependent variable, i.e., rental households, and also in correlating highly with the other independent variables so that their effect on rental demand could not be properly measured. Hence, it was decided that the best approach would be to develop a two-regression equation analysis.

The first equation used the combined 15-24 and >64 aged population as the sole independent variable, in a simple regression analysis. The close relationship existing between this population variable and rental households is illustrated in Chart II.2, which shows the similarity in the five-year period percentage change trend using census data.

Chart II.2

Percentage Change in Rental Households and
the Combined 15-24 and > 64 Aged Population
by Five-Year Periods



Source: Actuals: Census Data

Forecast: P.P.D.S., Ministry of Housing

The predictive ability of the basic equation was tested for the five-year period 1971 to 1976. (Section III)

The second equation involved a multiple regression using the following selected independent variables.

- number of divorces
- unemployment rate
- ratio of rent change to income change.

In this regression, the population effect on rental demand was excluded so as to measure the effect of these socio-

economic factors on rental demand. A rental demand forecast for the period 1976 to 1981 was then developed using this combined two-equation analysis.

Projections of the independent variables were produced by examining the historical trends since 1961, and taking a consensus of the short-term economic forecasts prepared by government and private industry organizations. The forecasts of the selected socio-economic factors are provided in Table II.2.

Table II.2

Forecasts of the Selected Independent Variables
Used in the Rental Demand Analysis

Variables	1976 (Actual)	1977 (Actual)	1978	1979	1980	1981
Number of Divorces	18,589	19,890	21,100	22,300	23,500	24,600
Unemployment Ratio (%)	6.2	7.0	7.0	6.5	6.5	6.0
Ratio of Rent Change to Income Change	.60	.70	.80	.85	.79	.77
15-24 and over 64 aged Population	2,291,280	2,323,200 (est)	2,355,200	2,387,200	2,419,100	2,451,100

Source: P.P.D.S., Ministry of Housing.

Appendix B provides a detailed technical explanation of the regression method used in preparing the forecast of housing requirements to 1981.

III. TESTING THE PREDICTIVE ABILITY OF THE REGRESSION ANALYSIS

The observed data period was taken from 1961 to 1971 inclusive. The actual data for the selected independent variables were used for the 'forecast' period 1971 to 1976. The results were as follows:

- The average annual increase in total housing demand for the five year period was predicted at 85,500 units. This was only 4.5% higher than the actual increase based on census data.
- An even better prediction was achieved with the rental housing demand analysis which estimated an average annual increase of 26,100 units. This under-estimated the actual increase by only 2.6%.
- An increasing trend in annual growth was predicted for total housing demand. Intuitively, this trend makes good sense given the strong economic expansion in the early 1970's with rising real incomes combined with the peak inflow of the 'post-war baby boom' population into the 'household forming' 20-to-34 age group.
- Table III.1 below, provides a summary of the predictions and their variation from actuals based on census data.

- Since the results of this forecast method are somewhat lower than generally accepted figures, it is useful for predictive purposes that the testing results for the period 1971-76 were somewhat higher than actual figures. This indicates that the forecast results for 1976-81 are more likely to be overstated than understated.

Table III.1

Regression Analysis Performance in Predicting
Housing Demand by Tenure in Ontario*
1971 to 1976

Variables	Average Annual Increase in Housing Demand 1971 to 1976			
	Actual (Census)	Prediction	Difference	
	Units	Units	Units	%
Total Demand	81,826	85,500	3,674	4.5
Rental Demand	26,802	26,100	(702)	(2.6)
Ownership Demand	55,024	59,400	4,376	8.0

*Excludes vacancy rate allowance and net replacement demand factors.

() Denotes under-forecast.

Sources: Census data 1971 and 1976
P.P.D.S. Ministry of Housing.

IV. FORECAST OF HOUSING DEMAND BY TENURE

As mentioned in Section I, while the regression analysis provided annual estimates of total housing demand, the results were considered to be most useful on an average annual basis for the five-year period 1976 to 1981. The primary reason for this condition is that the method is not sensitive enough to accurately predict the annual fluctuations in household growth caused by short-term changes in economic conditions. The forecast results will be discussed in this section, then the tenure pattern and the possible forecast range. The demand outlook will then be completed by developing a forecast of average annual housing requirements by tenure for the five-year period 1976-1981.

A. Total Housing Demand

Using the multiple regression method (referred to in Section II and Appendix B) which utilized the over-15 aged population and the average household size in Ontario as independent variables, an average annual increase in total housing demand of 71,500 units was predicted for the period 1976 to 1981. The results showed that the change projected in average household size was responsible for 25,300 units or 35% of the average annual increase in total housing demand. This substantial quantitative impact confirmed the importance of supporting the

projection of average household size with sound intuitive reasoning on the socio-economic outlook for the period 1976 to 1981, as discussed in Section II.

The annual estimates of total housing demand served a useful purpose in indicating the future growth pattern. The results showed a decreasing trend in housing demand for the forecast period 1976 to 1981, with an estimated decline from about 73,000 units per annum in 1977 to under 70,000 units by 1981.

The projected slowdown in population growth and the anticipated levelling out in the decrease of average household size were translated by the regression method into a decline of 10,000 households per annum from the average annual increase in total households that occurred in the period 1971 to 1976. Table IV.1, below, compares the percentage change in total households with the over-15 aged population, and also relates it to the decreasing trend in the average number of persons per household.

Table IV.1

Trends in Total Households, over-15 Aged
Population and Average Household Size in Ontario
1961 to 1981

Five-Year Periods	Total Percentage Change		Decrease in Average Household Size
	Total Households	Over-15 Aged Population	
1961-1966	14.3	12.5	0.1
1966-1971	18.5	15.5	0.2
1971-1976	18.4	12.7	0.3
<u>Forecast:</u>			
1976-1981	13.6	9.4	0.2

Sources: Census Data
Central Statistical Services,
Ministry of Treasury and Economics.
P.P.D.S., Ministry of Housing.

Despite the slowdown in population, total household growth remained at a high level in the period 1971 to 1976 due to the more rapid decrease in average household size.

While there were other socio-economic factors which had a significant effect on total housing demand, they were not used because of the likelihood of double counting their quantitative effect. It was assumed that the effect of a change in average household size would absorb the impact of other socio-economic factors since such variables as shelter costs, unemployment and personal income growth are considered to have a direct effect on average household size.

B. Rental Housing Demand

The two-equation regression analysis described in Section II indicated an average annual increase in rental demand of 17,500 units for the period 1976 to 1981. This represented about a 9,300 unit decline per annum from the average annual increase in the previous five-year period as shown in Chart IV.1 below.

Chart IV.1

Average Annual Increase in Rental Households
in Ontario by Five-Year Periods



Sources: Actuals: Census Data
Forecast: P.P.D.S. Ministry of Housing

The results of the analysis supported the intuitive reasoning that a slower rate of increase in rental demand could be expected in the future, given an aging of the population structure, and the combined effect of rising real incomes and a consumer preference for ownership.

It should be noted that a complete specification of all the factors affecting rental housing demand was not possible because of the effect of government intervention into the market which altered historic relationships. As an example, the ownership/rental costs ratio proved to have a substantial effect as an independent variable but was not used due to regulation of the rental market through Rent Review.

C. Ownership Housing Demand

Ownership demand was treated as a residual component in the analysis because of the greater stability of the historical trend in rental households, which permitted a more effective regression analysis of the rental component compared to the ownership component. On this basis, ownership housing requirements were projected at an average annual increase of 54,000 units for the period 1976 to 1981. However, a separate simple regression analysis was carried out on ownership demand to serve as a checking point for the forecast. The 25 to 64 aged population was used as the sole independent variable. The results indicated an

average annual increase of about 50,000 units in ownership demand for the period 1976 to 1981, thus adding support to the reliability of the forecast of total housing demand.

D. Forecast Range

The essential value of the projected maximum and minimum demand levels was that they provided useful limits to the most likely forecast, as well as indicating the sensitivity of housing demand to socio-economic conditions, especially demographic trends.

Table IV.2 provides a forecast range of housing demand by tenure, based on the methodology described in Section II.

Table IV.2

Average Annual Increase in Housing Demand*
by Tenure, Ontario 1976-1981

Outlook	Total Housing Demand	Rental Housing Demand	Ownership Housing Demand
Optimistic	77,100	18,900	58,200
Most Likely	71,500	17,500	54,000
Pessimistic	65,100	16,000	49,100

*Excludes vacancy rate allowance and net replacement demand factors.

Source: P.P.D.S., Ministry of Housing

The results of the regression analysis for the pessimistic outlook showed an average annual decrease in average household size of .02 from 3.1 persons in 1976. This assumption increased the housing demand forecast based on the basic population projection by approximately 17,800 units per annum. In contrast, the high assumption of .067 average annual decrease used in the optimistic outlook accounted for about 44,000 units representing just over 57% of the total requirements forecast. (Note that the population projection was kept constant for both high and low assumptions on average household size).

E. Total Housing Requirements

It is necessary to add a vacancy allowance, and a net replacement demand factor to the household growth to obtain total housing requirements.

There is no established method of determining what is a 'normal' vacancy level. The traditional method of estimating this component of total housing requirements has been to derive it from an examination of the historical trend in vacancy rate statistics prepared by C.M.H.C. However, recent research undertaken by the Ministry of Housing has indicated that C.M.H.C. statistics may have under-estimated the vacancy rate situation. Also, since there has been an absence, in previous studies

on housing requirements, of a commonly-accepted percentage of total stock that can be considered as a 'normal' vacancy level, a new method of establishing a 'normal' vacancy allowance is being investigated utilizing Census data on unoccupied stock by tenure.

For the purposes of this study, a vacancy allowance factor of approximately 3.0% of total annual household growth was used, because this appears to be the factor which is presently most commonly accepted.

Another component of housing requirements is the number of housing units needed to replace existing units which are withdrawn from the existing stock through demolitions and abandonments. While net replacement demand is relatively stable over the long-term period, it may be subject to considerable short-term fluctuation due to government action through, say, urban renewal and highway construction. An annual net replacement demand factor of .14% of total housing stock was used based on the historic relationship of demolitions to total housing stock over the 1966-1976 period. (This was identical to the method used in the Barnard study).

An average annual requirement of 2,200 units for the vacancy allowance and 4,000 units for net replacement demand for Ontario in the period 1976-1981 were derived using the above assumptions.

Thus total average annual housing requirements for Ontario in the period 1976 to 1981 were projected at 77,700 units. Table IV.3 below provides the forecast range for average annual housing requirements for Ontario over the 1976-1981 period using the assumptions described above, for the vacancy allowance and net replacement demand.

Table IV.3

Average Annual Increase in Housing Requirements*
By Tenure, Ontario 1976-1981

Outlook	Housing Requirements (Units)		
	Total	Rental	Ownership
Optimistic	83,600	21,400	62,200
Most Likely	77,700	20,000	57,700
Pessimistic	71,000	18,400	52,600

*Includes adjustments for vacancy allowance and net replacement demand.

Source: P.P.D.S. Ministry of Housing.

V. COMPARISON OF THE REGRESSION ANALYSIS WITH THE HEADSHIP RATE METHOD

The commonly used method of forecasting housing demand has been by projecting headship rates (i.e. the number of persons within a specific age-group who are household heads) and applying these rates to projected population by age-groups. To develop the forecast by tenure, the tenure pattern was extrapolated from the historical trend and then applied to total households. The purpose of this section will be to compare how well the headship rate method performed in forecasting housing demand in the period 1971 to 1976 in comparison to the multiple regression method, and then to show how the two methods differ in their forecasts for the period 1976 to 1981. Appendix C describes the methodology used in developing the housing demand forecasts by the headship rate method. It should be noted that the estimations of housing requirements for the vacancy allowance and also for net replacement demand have been omitted from this comparison in order to highlight the difference between the two methods in their household forecasts.

The variations of the forecasts from the actual Census data in the period 1971 to 1976, are indicated in Table V.1 illustrating the greater accuracy of the regression analysis forecast.

Table V.1

Comparison of Alternative Forecasts of Housing
Demand by Tenure for Ontario in the
Period 1971 to 1976

	Average Annual Increase in Housing Demand		
	Actual (Census)	Regression Method	Headship Rate Method
Total Units	81,826	85,500	73,295
- Rental	26,802	26,100	36,884
- Ownership	55,024	59,400	36,411
Percent Difference from Actual (%)			
- Total		4.5	(10.4)
- Rental		(2.6)	37.6
- Ownership		8.0	(33.8)

Sources: Actuals: Census Data 1971, 1976 Forecasts:
P.P.D.S. Ministry of Housing

() Denotes a shortfall in the forecast.

The under-estimation by the headship rate method was due to the headship rates increasing faster than the long-term average growth as a result of the changing profile of the population age-group structure and economic factors such as rising real incomes. These factors also explained the inability of the method to predict the fundamental shift in the tenure pattern involving a decrease in the rental proportion. The greater sensitivity of the regression method enabled it to pick up this changing trend with reasonable accuracy.

In comparing the forecasts for the period 1976 to 1981, considerable differences continued to exist between the two methods, as shown in Table V.2.

Table V.2

Comparison of Alternative Forecasts of Housing
Demand by Tenure for Ontario in the
Period 1976 to 1981

	Average Annual Increase in Housing Demand		
	(1) Regression Method	(2) Headship Rate Method	Difference (2) - (1)
Total Units	71,500	81,300	9,800
- Rental	17,500	45,700	28,200
- Ownership	53,900	35,600	(18,300)

() Denotes a negative difference.

Source: P.P.D.S. Ministry of Housing.

Based on past results it would appear that the headship rate method is continuing to over-estimate rental household growth. At the same time the regression method appears to be sufficiently flexible to incorporate such factors as the aging of the population structure, and the level of unemployment, in predicting a decline in the average annual increase in housing demand as well as a definite shift in the tenure pattern.

A major drawback of the headship rate method is that the factors influencing housing demand are not made explicit in the analysis. In contrast, the regression method develops quantitative estimates of the impact of specific socio-economic factors on housing demand.

In conclusion, the headship rate method places too much emphasis on the past ability of the 'potential household head' age-group population to form new households, so

that there is no sensitivity to shifting medium-term trends in housing demand. In comparison, the regression method provides greater forecasting flexibility assuming that the mathematical relationship between housing demand and the significant socio-economic factors holds true.

The two methods tend to complement each other with their differing characteristics, since the regression method is only useful as a medium-term forecasting tool, while the headship rate method is primarily useful in developing long-term projections of household growth.

VI. CONCLUSIONS

The results of this study highlight a general advantage of regression analysis for a medium-term forecast, namely it translates the impact of socio-economic factors on the forecasted variable into quantitative terms. Thus, in terms of the housing market, it provides a valuable bench-mark to any intuitive reasoning on the effect of future socio-economic conditions on housing demand. At the same time, this benefit pinpoints the two major shortcomings of the method. As mentioned previously, it is virtually impossible to completely specify all the factors influencing the dependent (i.e., the forecasted) variable. Hence, there is always the possibility that an important variable may be omitted from the analysis which would affect the forecast. The other main weakness of the method is that its forecasting accuracy is dependent on the accuracy in forecasting the independent variables.

The reliability of regression analysis in forecasting housing demand by tenure has already been illustrated in Sections III and V. The next step which is described below was to examine the implications of the forecast of housing requirements using this method regarding the supply side of the housing market in Ontario.

The average annual housing requirement for Ontario predicted by the regression method for the period 1971 to 1977 was 89,400 units. The average annual number of completions in the same period was 90,300 units, thus indicating that there was a virtual equilibrium position in the Ontario housing market by the end of 1977.

In examining the yearly differences between the completions rate and housing requirements as illustrated in Table VI.1, it can be seen that an excess supply situation existed in the years 1972, 1973, 1974, fostered by the expansionary economic conditions. This was followed by a two-year adjustment period (1975, 1976) of excess demand, as housing supply slowed down with rising costs and an excessive inventory position. Finally, 1977 was a stable market situation with the supply and demand for housing virtually in equilibrium.

Table VI.1

Relationship of Housing Requirements*
to Housing Supply in Ontario
1971 to 1977

Years	Incr. in Households	Vacancy Rate Allow.	Net Replacement Demand	Total Housing Reqmnts	# of Completions	Absolute Difference
1972/71	82,100	2,500	3,100	87,800	96,438	(8,638)
1973/72	82,100	2,500	3,200	87,800	98,262	(10,462)
1974/73	84,900	2,500	3,300	90,700	104,360	(13,660)
1975/74	86,300	2,600	3,500	92,400	81,865	10,535
1976/75	92,300	2,800	3,600	98,700	80,302	18,398
1977/76	73,200	2,200	3,700	79,100	80,717	(1,617)
Total 1977/71	500,900	15,200	20,400	536,400	541,944	(5,544)
Average Annual Increase 1977/71	83,500	2,500	3,400	89,400	90,324	(924)

() denotes an excess supply position

* all forecasts have been rounded to the nearest hundred.

SOURCES: Completions Data: C.M.H.C. Housing Statistics
Requirements: P.P.D.S., Ministry of Housing.

The average annual rental housing requirement for Ontario in the same period 1971 to 1977 was predicted at 26,600 units (includes 1,750 units per annum for vacancy allowance and net replacement demand) leaving the ownership housing requirement component at 62,800 units. While no official statistics exist on dwelling unit completions by tenure it was estimated that rental unit completions averaged about 24,800 units per annum, with ownership unit completions averaging 65,500 units, in the period 1971 to 1977. Thus a disequilibrium position

within the tenure pattern of the housing market was revealed of approximately 1,800 units per annum excess rental demand, and an excess ownership unit supply of about 2,700 units per annum in the period 1971 to 1977. In total numbers, by the end of 1977, it was estimated that an excess rental demand of 10,800 units, and an excess ownership unit supply of about 16,200 units existed. An examination of the housing market has indicated that this disequilibrium position was accentuated in the two latter years (1976 and 1977).

Based on projected average annual housing requirements of 77,700 units in the period 1976 to 1981 (Section IV) and given the average annual rate of completions for the period 1977 to 1979 of 78,200 units (actual completions of 80,717 in 1977, and a short-term forecast of 81,000 in 1978 and 73,000 in 1979), a completions rate of just under 77,000 units in 1980 and 1981 would be sufficient to keep supply and demand in the total housing market in relative equilibrium.

There are two main ways that the regression method of forecasting housing demand can be effectively utilized. Firstly, it can be used as a medium-term (5 years) forecasting method, thereby complementing short-term (annual) forecasts based on interpretation of current economic conditions, and long-term (10 years or more) forecasts that can be developed using the headship rate method (see Appendix C for methodology).

Secondly, the coefficients that are obtained from the regression method can be utilized in developing quantitative bench-marks for significant relationships existing between socio-economic factors and housing demand.

APPENDIX A

DEFINITIONS AND ASSUMPTIONS

DEFINITIONS

Correlation

This is the statistical term for the degree of association between two variables.

Dependent Variable

Is the variable whose value is estimated for a given value(s) of another variable(s).

In this forecast, for example, the dependent variable, total number of housing units required, was 83,600 when the value of another variable, average household size was 2.8 and 71,000 units when average household size was 3.0.

Independent Variable

Is the variable whose observed and predicted values are used for the estimation of the value of a dependent variable.

(Following the example used above, the independent variable was average household size.)

Linear Regression

Describes the relationship between two variables which can be represented by a straight line.

Multiple Regression

Describes the degree of relationship existing between three or more variables which can be expressed as a regression equation for estimating a dependent variable, x , from several independent variables (X_2, X_3, X_n) in functional notation (X_1, X_3, \dots, X_n).

ASSUMPTIONS

The mathematical relationship between the dependent and the independent variables that is developed by the regression technique is assumed to hold true in the real world situation. While the absolute exactness of this relationship cannot be expected, it does provide a quantitative bench-mark in the projection of the dependent variable. In order to increase the credibility of the projection it was important that the mathematical relationship should be capable of being supported by sound intuitive reasoning concerning the difference between potential and effective demand for housing.

Theoretically, the total number of single unattached adults and married couples represents the total potential demand for housing, because each single adult and each couple can be said to represent a separate household and therefore, to require a separate dwelling unit. In practice, the effective demand for housing depends on the number of separate households actually formed. The difference is explained by socio-economic factors such as net migration and the level of unemployment, because these factors influence, for example, the ability of young single adults to leave the family home and occupy a separate unit. Hence, the regression analysis in using existing households as the dependent variable, is attempting to estimate effective housing demand in the medium-term period (five years).

APPENDIX B

TECHNICAL EXPLANATION OF THE REGRESSION METHOD

I. UNDERLYING THEORY

The mathematical methods used in this housing demand forecast assume that change in housing demand operates according to a theoretical mechanism of housing stock growth. This conceptual explanation is not intended to be complete, but to some extent, it must be considered realistic before the mathematical results can be considered realistic.

The growth of housing stock is an evolutionary process that is primarily governed by population growth. However, at any given point in time, change occurring in various intervening factors can affect the rate of stock growth or division of total stock between ownership and rental. Examples of intervening factors are household size and the unemployment rate.

In the absence of continued change among intervening factors, further evolution of housing stock reverts to a growth rate primarily governed by population growth. In general, static levels of intervening factors do not permanently change the basic relationships between stock and population. However, persistently high levels of change among intervening factors eventually alters the underlying relationship.

The growth of housing stock is an evolutionary process, and the final outcome is not a fixed result. Final outcomes are cumulative results of the basic underlying relationship in combination with a particular set of intervening factors over time. Particular combinations of intervening factors may or may not occur for a single housing market.

II. DATA

A. Total Demand

The following measures were utilized in forecasting total demand.

- Annual estimates of the number of Ontario households, 1961-1976.

- Annual estimates of Ontario population older than 15 years, 1961-1976.
- Annual change in households population and average household size.
- Annual forecasts for average household size and population 1977-1981.

B. Rental Demand

The following measures were utilized in forecasting rental demand.

- Annual estimates of rental households 1961-1976.
- Annual estimates of Ontario population younger than 26 years and older than 64 years, 1961-1976.
- Annual change in the following variables listed below:
 - Rental Households
 - Population aged less than 26 and greater than 64.
 - The unemployment rate.
 - Number of divorces.
 - Rent-to-income ratio. The rent-to-income ratio was computed by dividing rental cost index by wage index scores.
- Forecasts for change in population, divorces, unemployment rate and Gross Debt Service (G.D.S.) ratio.

Data were obtained from both Ministry of Treasury and Economics and STATCAN sources. Annual estimates were not available for all measures, and linear interpolation between census years was used to

produce annual estimates where necessary. In the case of annual forecasts, a STATCAN extrapolation formula was used. Average household size was forecast from a series of regression equations.

III. Forecast Methods

Simple regression equations were derived from observed and interpolated data from 1961 to 1976. An equation that described the relationship between total households (proxy for total housing stock) and population greater than 15 years was calculated for total stock. An equation between rental households (rental stock) and population aged from 15 to 25 and greater than 64 years of age was calculated for rental stock.

A multiple regression equation was derived that described the relationship between annual change in total households and change among various socio-economic factors. Population change was entered into the equation as a controlling variable. A similar equation was derived for rental households.

The above steps provided a population equation and a socio-economic equation for total households and also for rental households. Forecasts for a particular year were obtained by substituting forecasts for rental or total households due to population growth. Socio-economic equations forecasted changes in households due to change among socio-economic factors. A total of population and socio-economic effects provided an overall forecast for a particular year. Ownership household forecasts were obtained by subtracting rental from total forecasts. An independent simple regression analysis using the population age group 25-64 was then run as a check on ownership demand.

All four regression equations that were derived from observed and interpolated data were solved using 1977 forecasts for independent variables. Total and rental household forecasts were obtained by summing population and socio-economic effects results from overall 1977 forecasts.

Forecasts for each subsequent year (1978-1981) were obtained by recalculating the population equations. Data from the oldest year included were eliminated and the most recent forecast was included as data. For example, 1977 forecasts were obtained from observed and interpolated data from 1961-1976. 1978 forecasts were obtained from 1962 to 1976 observed data and 1977 forecast data. The equations that described socio-economic factors were not recalculated. Forecasts for independent variables in the desired year were substituted into socio-economic equations and the recalculated population equations.

Notes

- Coefficients of determination (r^2) for all population equations exceeded .995. All regression coefficients (b) were between .50 and .60.
- All multiple correlation coefficients (R^2) for socio-economic equations exceeded .85. Coefficients of determination among independent variables were less than .25.
- The use of two equations to estimate overall forecasts is not a mathematically exact method. A small amount of socio-economic effects were double counted. The amount of over-lap was small, and the results were not greatly affected.

APPENDIX C

FORECAST OF HOUSING DEMAND BY TENURE IN ONTARIO FOR THE PERIODS 1971-1976 AND 1976-1981 USING THE HEADSHIP RATE METHOD

The headship rate is defined as the proportion of household heads in a given population grouping. In this forecast, family and non-family headship rates were projected assuming a continuation of previous trends towards new household formation by the same population. These estimated headship rates were then applied to the population forecast by age to derive an estimate of the total number of households, family and non-family for the forecast period. The tenure forecasts were derived by extrapolation of the long term trend in the tenure pattern. This method is identical to that used in the Report "Ontario Housing Requirements 1976-2001" prepared by P. Barnard Associates Ltd. and also in Statistics Canada's "Household and Family Projections for Canada and the Provinces to 2001". The population projections by age were obtained from the Central Statistical Services, Ministry of Treasury and Economics, and were based on a low fertility rate assumption of 1.61 by 1986 and an annual net migration of 25,000 persons.

FORECAST 1971 to 1976

The family and non-family headship rates by ten year age groupings were projected to 1976, based on the past trends as described in the Appendices to the Report "Ontario Housing Requirements 1976-2001" by P. Barnard Associates Ltd. and as shown in Table C.1 below.

Table C.1Projected Headship Rates to 1976

Population Age-Groups	1971 (Census)			1976 Forecast		
	Total	Family	Non-Fam	Total	Family	Non-Fam
15 - 24	.11	.08	.03	.12	.08	.04
25 - 34	.45	.39	.05	.46	.40	.06
35 - 44	.50	.46	.04	.51	.47	.04
45 - 54	.52	.46	.06	.53	.47	.06
55 - 64	.55	.43	.12	.56	.44	.12
65+	.56	.32	.24	.58	.32	.26

Sources: 1971: Census data

1976: Appendices to the Report "Ontario
Housing Requirements 1976-2001"
P. Barnard Associates Ltd.

These projected headship rates were then applied to the 1976 census population by age groups, to derive households, by the same age groups as given in Table C.2 below.

Table C.2

1976 Forecast of Population and Households
by Specific Age Groups

Population Age - Group	1971 Census Data (Actuals)		1976 Forecast	
	Population	Households	Population	Households
15 - 24	1,387,500	149,195	1,552,355	186,283
25 - 34	1,045,495	462,020	1,302,265	599,042
35 - 44	942,660	472,909	964,545	491,918
45 - 54	850,945	437,785	936,920	496,568
55 - 64	623,595	344,115	695,680	389,581
65+	644,410	362,940	738,925	428,577
Total	5,494,605	2,228,140	6,190,690	2,591,969
Absolute Change			696,085	363,829

Sources: 1971: Census Data
1976 Population: Census Data
1976 Households: P.P.D.S. Ministry of
Housing

The tenure pattern over the same historical period 1951 to 1971 was then extrapolated and applied to the projected 1976 total households as shown in Table C.3.

Table C.3Forecast of Household by Tenure 1971-1976

	(1971 Census) Actuals			1976 Forecast		
	Total	Rental	Ownership	Total	Rental	Ownership
Units	2,225,490	825,150	1,400,340	2,591,969	1,009,572	1,582,397
% of Total	100.0	37.08	62.92	100.00	38.95	61.05
Annual Incr. 5yr Avg				73,295	36,884	36,411

Sources: 1971: Census Data

1976: P.P.D.S. Ministry of Housing

FORECAST 1976-1981

The same methodology was used to project household formation to 1981. Table C.4 indicates family and non-family headship rates based on the trend from 1961 to 1976.

Table C.4Projected Headship Rates

Population Age - Groups	1976 (Census) Actuals			1981 (Forecasts)		
	Total	Family	Non-Fam	Total	Family	Non-Fam
15 - 24	.13	.08	.05	.150	.087	.063
25 - 34	.47	.39	.08	.500	.400	.100
35 - 44	.52	.47	.05	.543	.483	.060
45 - 54	.53	.47	.06	.540	.477	.063
55 - 64	.56	.44	.12	.574	.447	.127
65+	.59	.32	.27	.610	.310	.300

Sources: 1976: Census Data

1981: P.P.D.S. Ministry of Housing

These estimated headship rates were then applied to the population projections by the same age groups to derive household forecasts by age of household head.

Table C.5

1981 Forecast of Population and Households
by Specific Age Groups

Population Age-Groups	1976 Census		1981 Forecast	
	Population	Households	Population	Households
15 - 24	1,552,355	199,280	1,623,602	243,540
25 - 34	1,302,265	607,720	1,483,180	726,758
35 - 44	964,545	501,155	1,107,427	598,011
45 - 54	936,920	497,045	938,539	506,811
55 - 64	695,680	391,670	794,213	452,701
65+	738,925	437,750	827,501	513,051
Total	6,190,690	2,634,620	6,774,462	3,040,872
Absolute Change			583,772	406,252

Sources: 1976: Census Data

1981: Population: Central Statistical
Services, Ministry of Treasury and
Economics.

1981: Households: P.P.D.S., Ministry of
Housing.

The tenure pattern over the same period 1961 to 1976
was extrapolated to 1981 and applied to the projected
1981 total households as shown in Table C.6

Table C.6

Forecast of Households by Tenure 1976 to 1981

	1976 (Census)			1981 Forecast		
	Total	Rental	Ownership	Total	Rental	Ownership
Units	2,634,620	958,370	1,676,250	3,040,900	1,186,900	1,854,000
% of Total	100.00	36.38	63.62	100.00	39.03	60.97
Average Annual Increase 1976-81				81,300	45,700	35,600

Sources: 1976: Census Data

1981: P.P.D.S., Ministry of Housing.

